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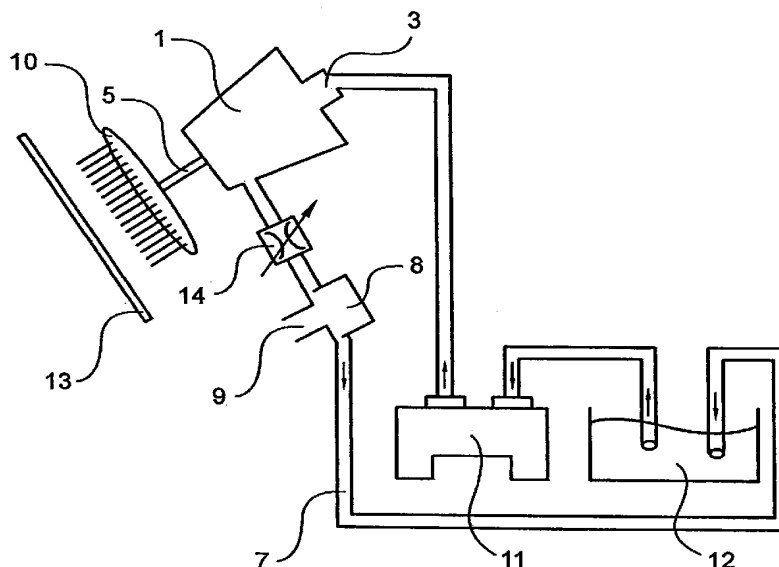
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(54) Title: HYDRAULIC MOTOR FOR DRIVING ROTATIONAL TOOLS



(57) Abstract: A hydraulic motor, particularly for driving rotational tools, comprising a chamber (1), which, at least at a part of its internal surface, has a shape of a solid of revolution, and is provided with a fluid inlet opening (3) and with at least one fluid outlet opening (6). In the chamber (1) is arranged a rolling rotor (4), represented by a body of a rotary shape, which is supported on a holding device in a manner enabling precessional motion of the shaft (5) of the rolling rotor (4). Each fluid outlet opening (6) is connected by a line (7) with a fluid tank (12). Using e.g. a valve (8) in the lines (7) back to the fluid tank, a part of the fluid can be directed at a working piece (13). This renders the fluid-driven rolling rotor machines suitable for both the dry working processes and for the wet working processes.

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## HYDRAULIC MOTOR FOR DRIVING ROTATIONAL TOOLS

Technical Field

The invention relates to a hydraulic motor, particularly for driving rotational tools, comprising a chamber, which, at least at a part of its internal surface, has a shape of a solid of revolution, and is provided with a fluid inlet opening and with at least one fluid outlet opening, while in the chamber is arranged a rolling rotor, represented by a body of a rotary shape, which is supported on a holding device in a manner enabling precessional motion of the shaft of the rolling rotor.

Background Art

A number of appliances are known in which hydraulic motors are used for driving rotational tools. With hand-held and mobile type appliances, it is advantageous to use the ordinary water-supply line as a source of the pressure fluid. With this type of appliance, the Pelton turbine and modifications of the Pelton turbine, or various modifications of the water wheel are used as an hydraulic motor to serve the purpose of conversion of the pressure energy and kinetic energy of the water in the supply pipeline into the rotational energy, which is used for driving the particular appliance, which is often intended for utilization in a cleaning process using water. The drawback of all these solutions is the fact that the torsional moment of the shaft is accompanied by excessively high speed, which is not suitable for the final utilization, and that is why the speed has to be reduced considerably by means of gears. At the same time, it is not possible, due to the principle reason, to design such a hydraulic motor with unlimitedly small dimensions, because the basic unit, which converts the water flow energy into the torsional moment energy of the shaft, is the rotor, and the smaller the hydraulic motor's rotor diameter, the higher the rotor speed, and the lower the torsional moment. This objectively results in the increased complexity of the gears and in the increased number of wheels of the gears.

From the international application PCT/CZ97/00034, which has been

published under the number WO98/17910, the disclosure of which is incorporated by reference, a fluid machine with a rolling rotor is known that comprises a chamber fitted with a fluid inlet and with at least one outlet opening. The rolling rotor, which is formed by a solid of revolution, is supported on a holding device before the outlet opening. This application does not deal with the removal of the driving fluid.

From the international application PCT/CZ99/00013, which has been published under the number WO99/61790, the disclosure of which is incorporated by reference, a hydraulic motor is known that comprises a chamber fitted with a fluid inlet and with at least one outlet opening. Before the outlet opening, a rolling rotor, which is formed by a solid of revolution, is supported on a holding device. At least the internal surface of the chamber has the shape of a solid of revolution. The diameter of the chamber narrows, and the chamber is open on the side with the greatest diameter, and it is enclosed with a wall on the side with the smallest diameter. In the middle of the wall is arranged an opening for the shaft carrying the rolling rotor. The shaft protrudes through the opening, with a clearance. Inside the chamber, the shaft has a protrusion whose diameter is greater than the diameter of the opening in the wall. A number of outlet openings are arranged in the wall around the opening. For one of the advantageous versions, it is assumed that the fluid from the hydraulic motor is being removed out of the working area, which makes it possible to use the hydraulic motor for dry working processes as well. From the point of view of the design, this aim has been achieved by enclosing the chamber of the hydraulic motor in an additional, sealed-off housing. The drawback is the fact that another housing has to be used, in addition to the hydraulic-motor chamber, which causes the manufacturing costs to increase. Furthermore, this version neither deals with the flow control, nor makes it possible to bring at least a portion of the flow to the surface being treated.

So, the aim of the invention is to adapt the known fluid-driven rolling rotor machines in such a way that they are as simple as possible from the point of view of their design, and that they are suitable, after possible adaptations, both for the so-called dry working processes and for the so-called wet working processes. For

the purposes of this application, the dry working process is to be interpreted as a working process without any fluid being brought to the working tool. Then, the wet working process is to be interpreted as a working process during which the cooling, cleaning, polishing, or rinsing fluid, or the fluid of another type is being brought to the working tool or to the surface being treated.

#### Disclosure of Invention

The aim that has been mentioned is achieved by means of a hydraulic motor, particularly for driving rotational tools, comprising a chamber, which, at least at a part of its internal surface, has a shape of a solid of revolution, and is provided with a fluid inlet opening and with at least one fluid outlet opening, while in the chamber is arranged a rolling rotor, represented by a body of a rotary shape, which is supported on a holding device in a manner enabling precessional motion of shaft of the rolling rotor, pursuant to the invention based on the fact that each fluid outlet opening is connected by a line with a fluid tank.

An advantage of the hydraulic motor pursuant to the invention is the fact that the hydraulic motor, using a simple constructional adaptation, makes it possible to return, without further utilization, the fluid into the fluid tank, which is important for the so-called dry working process. Also, from the point of view of the costs, the fluid saving is important, which is achieved by returning a portion of the flow rate into the tank.

If the fluid is to be brought to the area being treated, and precise dosing is required of the volume being brought to the area, it is advantageous if a controllable flow divider with an outlet is inserted in the fluid line.

For optimum setting of the pressure conditions in the chamber of the hydraulic motor, it is advantageous if a controllable throttle valve is arranged before the flow divider and/or in the flow divider and/or in the outlet.

In an advantageous embodiment, an exchangeable tool is attached at the

end of the shaft which protrudes from the chamber, and the flow divider outlet is directed into the area of the tool.

For easy control, the chamber and the flow divider have been incorporated into a common handle.

### Brief Description of Drawings

The hydraulic motor pursuant to the invention will be described in detail by means of examples of particular embodiments represented in the drawings, in which individual Fig. represent the following:

Fig. 1 – Hydraulic motor without a flow divider

Fig. 2 – Hydraulic motor with a flow divider

Fig. 3 – Hydraulic motor with a flow divider, and with an attached cleaning brush

### Modes for Carrying Out the Invention

Fig. 1 represents the first embodiment of the hydraulic-motor for driving rotational tools by means of pressure liquid. The pressure liquid may be supplied not only by the represented pump 11, but, in fact, by any appliance providing pressure liquid, e.g. water supply line. The hydraulic motor comprises chamber 1, which has the shape of a truncated cone with an angle of the lateral surface of  $7^\circ$ . On the end with the greater diameter, the chamber 1 is enclosed with a cover 2, which is provided with a fluid inlet opening 3. On the opposite end, in the middle of the front end of the chamber 1 is an opening. Through the opening protrudes a shaft 5, which carries a rolling rotor 4. The rolling rotor 4 may have the shape of any solid of revolution, namely, not only the represented shape of a truncated cone, but also the shape of a sphere, hemisphere, hollow hemisphere, etc. The shaft 5 passes through the opening at the chamber's front end with a clearance, which enables the shaft 5 to rotate and incline, since it performs the precessional

motion. Inside the chamber 1, the shaft 5 has a protrusion, whose diameter is greater than the diameter of the opening at the front end of the chamber 1. The opening and protrusion may be fitted with a sealing, which has not been depicted, to prevent leakage of the fluid from the chamber 1. In the chamber 1, the rolling rotor 4 is fixed to the shaft 5. The end of the shaft 5, which protrudes from the chamber 1, can carry an adapter, which has not been depicted, for fastening exchangeable tools 10.

At the front end of the chamber 1 have been made two fluid outlet openings 6, which are connected by means of lines 7 with a fluid tank 12. Of course only one outlet opening 6 can be used, however, due to the engineering reasons, it may sometimes be more useful to divide the total needed flow cross section among several outlet openings 6. The fluid outlet openings 6 may be made in the sides of the chamber 1 as well. Such an embodiment is depicted in Fig. 2 and 3. To ensure optimum functioning of the hydraulic motor, the fluid outlet openings 6 should not be situated in the area of the sides which is, in Fig. 2, above the upper edge of the rolling rotor 4.

The pressure liquid is brought by the pump 11 through the inlet opening 3 into the chamber 1. From the chamber 1, the pressure liquid flows out through the outlet openings 6, and then, through the lines 7, it flows back into the fluid tank 12. The water flow causes the protrusion of the shaft 5 of the rotor 4 to lean against the front end of the chamber 1, and at the same time, the rotor 4 inclines to the side (this is depicted with a dashed line in Fig. 1), and starts rolling on the inside surface of the circumferential shell of the chamber 1. This means that the shaft 5 performs the precessional motion. With respect to the fact that the difference between the maximum diameter of the rotor 4 and the diameter of the chamber 1 at the area, where the rotor 4 is rolling, is approximately no more than 1 mm, the swing of the shaft 5 is negligible for the anticipated field of use. However, these 'micro-oscillations' of the shaft 5 are useful, for example, during the removal of an old grime, because they help to disintegrate the grime.

The embodiment according to Fig. 1 is used for applications requiring the

liquid to be taken away from the working area, which makes it possible to use the hydraulic motor for the dry working processes.

Such an embodiment of the hydraulic motor can be used for example as a drill, grinder, winding apparatus, mixing apparatus, blender, electric generator drive or pump drive, as a polishing machine, planing machine, circular saw, screwdriver, nut runner, rotational toothbrush, milling machine, as a hydraulic drive of parts of machines, etc.

However, with some versions, it is useful if a portion of the liquid from the chamber 1 is brought to the area of the tool 10. The versions according to Fig. 2 and 3 serve this purpose.

Hydraulic motors according to Fig. 2 and 3 differ from the version of Fig. 1 only by the number and placing of the outlet openings 6 of the chamber 1. In addition to this, a flow divider 8, which divides the flow into two portions, has been arranged in line 7 of the embodiments according to Fig. 2 and 3. One portion of the flow flows into the tank 12, the other portion of the flow is brought, through an outlet 9, to the area being treated. The proportion between the flow into the fluid tank 12 and the flow through the outlet 9 can naturally be adjusted, and both the flow through the outlet 9 and the flow into the tank 12 can be zero as well. Various design versions of the adjustable flow dividers 8 are generally known, and that is why it is not necessary to describe them to experts.

In addition to the flow divider 8, a throttle valve 14 can be inserted in the line 7. In embodiments according to Fig. 2 and 3, the throttle valve 14 has been inserted, from the point of view of the flow, before the divider 8. However, throttle valve 14 may be arranged directly in the divider 8 or in the outlet 9.

Fig. 3 shows that the tool 10, in this case a rotational brush, is attached at the end of the shaft 5, which protrudes from the chamber 1. The pump 11 is delivering the liquid through the inlet opening 3 into the chamber 1, and the water flow causes the rotor 4 to roll on the internal surface of the circumferential shell of



the chamber 1. The resulting precessional motion of the shaft 5 has a minimum swing (approximately no more than 1 mm), and so the rotational movement of the tool 10 prevails. However, small oscillations of the tool 10 effectively disintegrate the grime on the surface 13, which is being cleaned, and so they considerably improve the resulting cleaning effect. From the chamber 1, the liquid flows through the outlet opening 6, and through the throttle valve 14 into the flow divider 8, in which the flow is divided according to the actual setting of the divider 8 in such a way that a portion of the fluid flows through the outlet 9 to the surface 13, which is being cleaned, washing away the dirt. The remaining portion of the fluid flows through the line 7 into the fluid tank 12. By adjusting the divider 8, the total flow may be directed through the line 7 into the tank 12, which results in the flow through the outlet 9 being zero. The throttle valve 14 makes it possible to create fluid counter pressure, thus optimizing the functioning of the hydraulic motor.

Measurements have been carried out with a hydraulic motor that has the rotor 4 with a diameter of 42 mm and the chamber 1 with a diameter of 43.6 mm at the area where the rotor 4 is rolling. The measurements have proved that, depending on the required value of the torsional moment, it is possible to control the total flow of the liquid through the hydraulic motor in the range from 0.12 to 0.25 litres per a second at a hydrostatic pressure of the liquid at the source equalling to 0.42 MPa. Then, working speed of the tool 10 ranges from 245 to 160 rpm, and a portion from 0 % to 100 % of the overall volume of the liquid flowing from the chamber 1 of the hydraulic motor may be brought through the outlet 9 to the tool 10.

Connection according to Fig. 3 may be used as a cleaning appliance for removing grime from the surface 13. Then, in such a case, it is useful if the chamber 1 and the throttle valve 14 and the flow divider 8 are incorporated into a common handle, which is connected by means of flexible hoses to the pump 11 and the fluid tank 12.

A typical example of the cheapest driving fluid is water, which is used for driving the hydraulic motor and, at the same time, it may serve for rinsing the

surface 13, which is being cleaned. In some cases, it is advantageous to use various cleaning solutions as well.

#### Industrial Applicability

The hydraulic motor pursuant to the invention can be used, if connected with appropriate brushes, for cleaning or polishing of various surfaces. Furthermore, it can also be used for grinding, drilling, milling, and mixing of materials, and, as well, for the body massage, and as a driving unit for special machines and tools, for example for milling of stone, cutting and drilling of stone, concrete and similar materials. In particular, utilization of the hydraulic motor in cleaning and decontamination of animals, persons and things appears to be especially advantageous.

It is advantageous to use the hydraulic motor pursuant to the invention in plants with the explosion hazard environment, where electric-motor spark ejection would bring about the explosion risk, that is, for example in chemical plants, in the mining industry, etc. Furthermore, utilization of the hydraulic motor is advantageous in humid and wet environments, where there is an intensified danger of an electrical accident.

## CLAIMS

1. A hydraulic motor, particularly for driving rotational tools, comprising a chamber (1), which, at least at a part of its internal surface, has a shape of a solid of revolution, and is provided with a fluid inlet opening (3) and with at least one fluid outlet opening (6), while in the chamber (1) is arranged a rolling rotor (4), represented by a body of a rotary shape, which is supported on a holding device in a manner enabling precessional motion of the shaft (5) of the rolling rotor (4), **characterized by the fact** that each fluid outlet opening (6) is connected by a line (7) with a fluid tank (12).
2. The hydraulic motor as in Claim 1, **characterized by the fact** that in the fluid line (7) is inserted an adjustable flow divider (8) with an outlet (9).
3. The hydraulic motor as in Claim 1 or 2, **characterized by the fact** that an adjustable throttle valve (14) is arranged before the flow divider (8) and/or in the flow divider (8) and/or in the outlet (9).
4. The hydraulic motor as in Claim 2 or 3, **characterized by the fact** that an exchangeable tool (10) is attached at the end of the shaft (5), which protrudes from the chamber (1), while the outlet (9) of the divider (8) is directed to the area of the tool (10).
5. The hydraulic motor as in any of the previous Claims 2 to 4, **characterized by the fact** that the chamber (1) and the flow divider (8) are incorporated into a common handle.

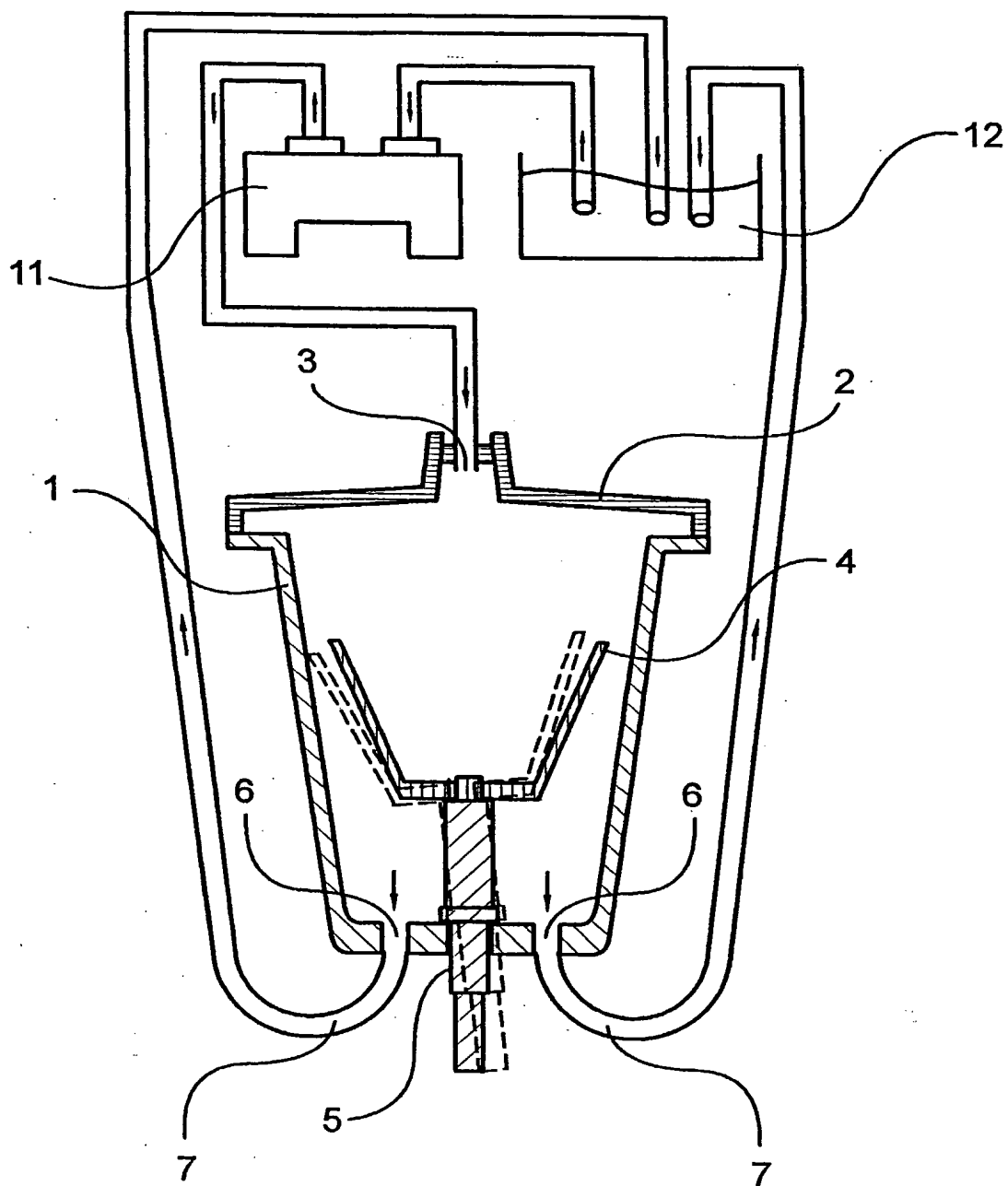


Fig. 1

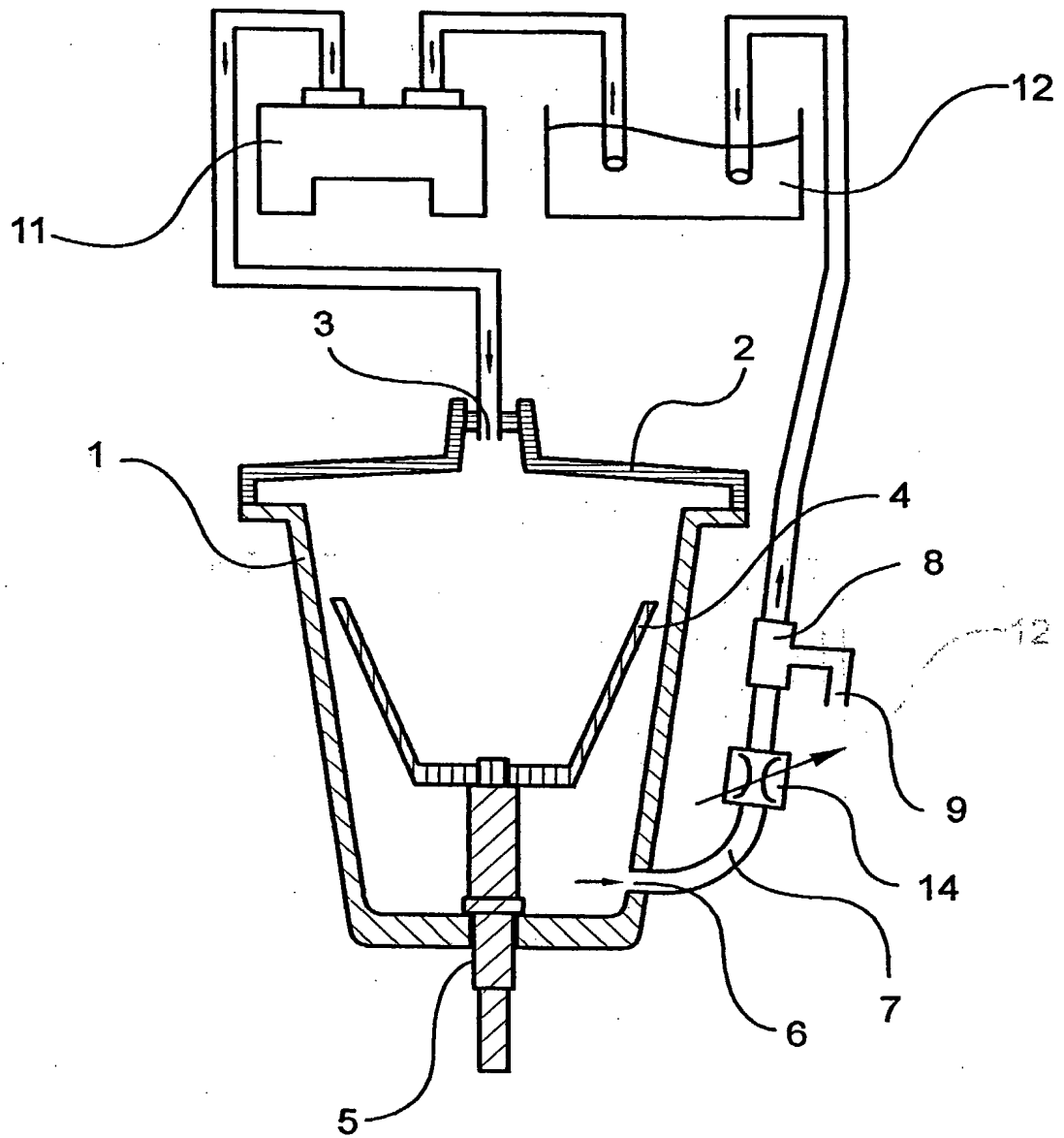
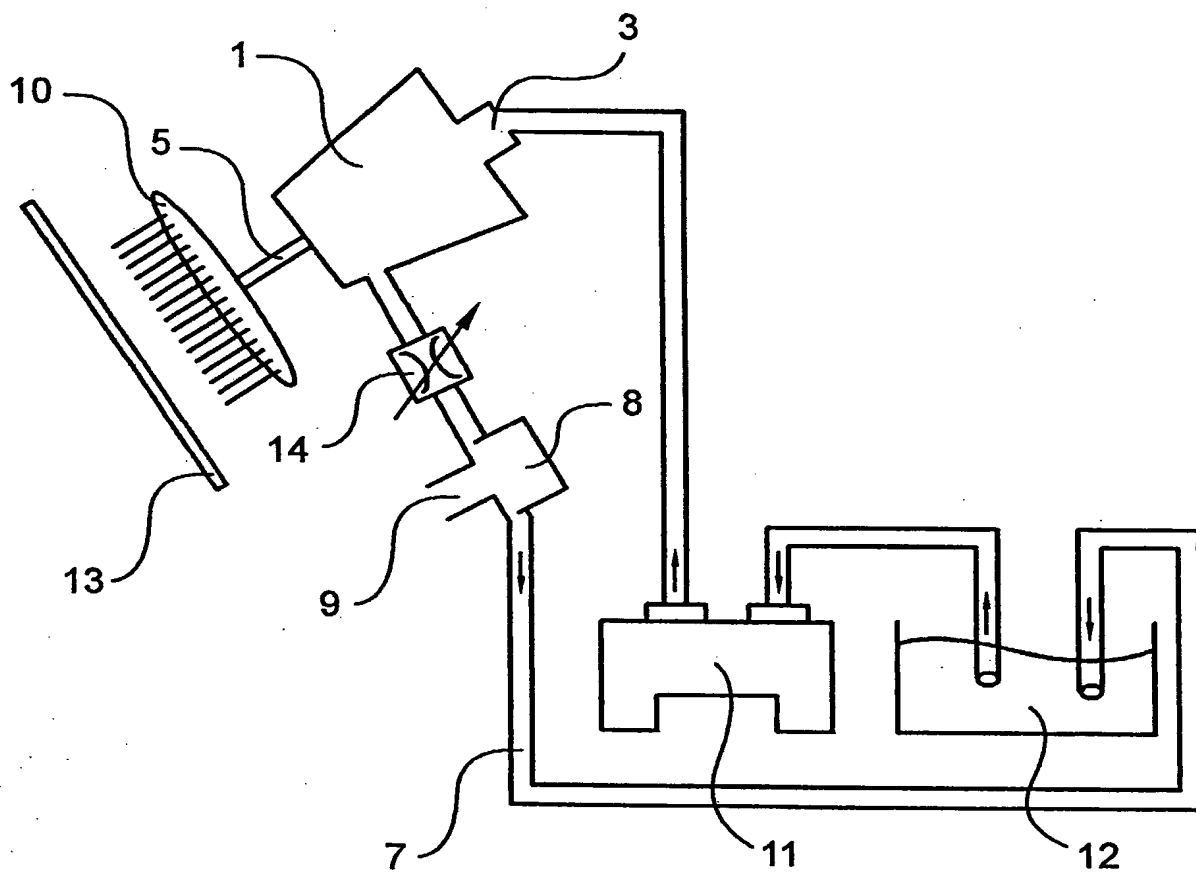


Fig. 2

**Fig. 3**

# INTERNATIONAL SEARCH REPORT

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**A. CLASSIFICATION OF SUBJECT MATTER**  
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According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 99/61790 A1 (SEDLACEK, MIROSLAV; HOSTIN, STANISLAV) 2 December 1999 (1999-12-02) cited in the application page 3, paragraph 3 page 3, paragraph 6 page 6, paragraph 7 - page 7, paragraph 1; figures	1-4
Y	GB 112 954 A (THOMAS DUNSEITH MACFARLANE; ALFRED JOHN PENNEY) 7 February 1918 (1918-02-07) page 1, line 12 - line 25 page 2, line 14 - line 73 page 2, line 113 - page 3, line 37; figures  ----- -/--	1-4

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 99/03392 A1 (BRENDON LIMITED; HENDY, ROBERT, JOHN) 28 January 1999 (1999-01-28) abstract; figures 1,2,5,6 page 1, line 1 - line 5 page 1, line 17 - line 26 page 2, line 5 - page 4, line 11 page 5, line 1 - line 15 -----	1
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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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**ABSTRACT:**

A hydraulic motor, particularly for driving rotational tools, comprising a chamber (1), which, at least at a part of its internal surface, has a shape of a solid of revolution, and is provided with a fluid inlet opening (3) and with at least one fluid outlet opening (6). In the chamber (1) is arranged a rolling rotor (4), represented by a

body of a rotary shape, which is supported on a holding device in a manner enabling precessional motion of the shaft (5) of the rolling rotor (4). Each fluid outlet opening (6) is connected by a line (7) with a fluid tank (12). Using e.g. a valve (8) in the lines (7) back to the fluid tank, a part of the fluid can be directed at a working piece (13). This renders the fluid-driven rolling rotor machines suitable for both the dry working processes and for the wet working processes.